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(Animal Product Series, No. 3.)

THE  
AGRICULTURAL LEDGER

1911—No. 1.

GUANO.

*Bat and Bird Guanos in India.*

BY I. H. BURKILL.

It is well known that bat and bird guanos are used as manures **DEPOSITS** in India where available, but the supply is very small. The **RARE** following sums up all the information which has been brought together by an enquiry recently undertaken.

Bat or bird guano only accumulates in suitable caves, and they are generally rare in India. More of such caves are to be found in Tenasserim than in any other part of the country: there the curious abrupt limestone hills which rise out of the alluvium are often perforated by long winding caverns whence bat dung is extracted for use. Similar caverns occur from South-Western China to the Malay States and doubtless in many parts of the Malay islands. Ceylon also possesses bat caves.

The bat guano caves of Tenasserim are the property of Govern- **Tenasserim** ment and the rights of extracting the guano from the larger caves **caves.** are sold yearly, or from the smaller caves at suitable intervals. The following table gives the amount of guano extracted and the revenue realised by the sale of the collecting rights.

Statement showing the Quantity of Bat's Guano collected and revenue realised therefrom in the Thaton, Amherst, Tavoy and Mergui districts during the past six years.

| Name of District. | Year during which collected. | Quantity collected in baskets. | Purpose for which collected. | Amount of revenue realized. | If used locally, at which rate sold. | Any other information that may be of interest.  |
|-------------------|------------------------------|--------------------------------|------------------------------|-----------------------------|--------------------------------------|---|
| 1                 | 2                            | 3                              | 4                            | 5                           | 6                                    | 7   |
| Thaton            | 1903-4                       | 5,000                          | ..                           | Rs. 2,380                   | Rs. 50 per 100 at Hlaingbwe cave and | It is collected for the purpose of manuring vegetables. One basket of guano equals to 5 lbs. These figures are estimates of the quantities that might have been collected from the Kyauktang, Kyauksemye, Kyau-gun and Minaw caves. |
|                   | 1904-5                       | 4,800                          | ..                           | 2,380                       | ..                                   |   |
|                   | 1905-6                       | 4,500                          | ..                           | 2,380                       | ..                                   |   |
|                   | 1906-7                       | 4,500                          | ..                           | 2,275                       | ..                                   |   |
|                   | 1907-8                       | 17,222                         | ..                           | 2,905                       | Rs. 75 at Pagat.                     |   |
|                   | 1908-9                       | 5,400                          | ..                           | 3,465                       | ..                                   |   |
| Amherst           | 1903-4                       | ..                             | ..                           | ..                          | ..                                   | The Kayon, Sahn and Damat caves have very small deposits. The deposits in the Wingo and Paya caves near Kyrikmaraw are larger. The weight of a basket in Amherst is reported to be 5 viss or 23.8 lbs.                              |
|                   | 1904-5                       | 2,200                          | ..                           | 640                         | ..                                   |   |
|                   | 1905-6                       | 2,200                          | ..                           | 420                         | ..                                   |   |
|                   | 1906-7                       | 3,000                          | ..                           | 655                         | ..                                   |   |
|                   | 1907-8                       | 2,900                          | ..                           | 680                         | ..                                   |   |
|                   | 1908-9                       | 2,800                          | ..                           | 880                         | ..                                   |   |
| Tavoy             | 1903-4                       | ..                             | Exported to Moulmein         | ..                          | ..                                   | It is not annually collected. It is found in considerable quantities in Southern and Middle Mergui. The weight is not known.  |
|                   | 1904-5                       | ..                             | for manure in gardens        | ..                          | ..                                   |   |
|                   | 1905-6                       | ..                             | ..                           | ..                          | ..                                   |   |
|                   | 1906-7                       | 546                            | ..                           | 50                          | ..                                   |   |
|                   | 1907-8                       | ..                             | ..                           | ..                          | ..                                   |   |
|                   | 1908-9                       | 200                            | ..                           | 390                         | ..                                   |   |
| Mergui            | 1903-4                       | 1,500                          | ..                           | 400                         | 14 annas per basket.                 | It is chiefly used as manure for rubber cultivation. Collection is made in and among the caves of Upper and Lower Tavoy and in those of Boknyin township. The weight of a basket varies from 45 to 50 lbs.                          |
|                   | 1904-5                       | 2,050                          | ..                           | 500                         | ..                                   |   |
|                   | 1905-6                       | 2,000                          | ..                           | 300                         | ..                                   |   |
|                   | 1906-7                       | 800                            | ..                           | 400                         | ..                                   |   |
|                   | 1907-8                       | ..                             | ..                           | 390                         | ..                                   |   |
|                   | 1908-9                       | 800                            | ..                           | 390                         | ..                                   |   |

The guano extracted is used chiefly by Chinamen on the gardens where vegetables are raised; it is also used largely for manuring plantations of durian (*Durio Zibethinus*).

## Guano in India. (I. H. Burkill.)

So far as has been ascertained there is at present little, if any, export of the substance to other countries. CHEMICAL  
COMPOSITION

As is the case with all guanos there is probably great variation in the composition of samples obtained from different places.

In the *Agricultural Journal of India* (vol. iv, 1909, pp. 379—81) analyses are given of three samples of guano obtained from near Kyaukse.

No. I, the new deposit, was of a dry, powdery consistency, and on examination numerous particles of the elytra of beetles and the hard outer coverings of other insects were easily distinguishable; in fact, it had the appearance of being composed of the ground-up, hard parts of insects.

No. II was an older deposit and had not the same powdery nature as No. I, but was largely solidified, darker brown in colour, and the remains of insects, though still to some extent recognisable, were not so easily distinguished.

No. III, the oldest deposit obtained, was practically one solid mass, and when dug out was in large lumps. It was of a still darker brown colour and the insect remains were difficult to discern.

The following analyses, made by the Agricultural Chemist, Mandalay, give an idea of the manurial value of these three samples:—

### *Result of analysis of guano (Cave deposits).*

|   | Sample<br>No. I,<br>Upper<br>deposit. | Sample<br>No. II,<br>Middle<br>deposit. | Sample<br>No. III,<br>Lower<br>deposit. |
|---|---------------------------------------|---|---|
| Moisture . . . . .                            | 15.88                                 | 3.73                                    | 2.69                                    |
| Dry Substance—                                |                                       |   |   |
| Ash . . . . .                                 | 28.00                                 | 52.85                                   | 71.94                                   |
| † Combined water and organic matter . . . . . | 72.00                                 | 47.15                                   | 28.06                                   |
|   | 100.00                                | 100.00                                  | 100.00                                  |
| * Containing:—                                |                                       |   |   |
| Percentage on dry matter—                     |                                       |   |   |
| Phosphoric acid . . . . .                     | 2.13                                  | 1.06                                    | 1.62                                    |
| Potash . . . . .                              | .76                                   | .68                                     | .59                                     |
| Lime . . . . .                                | 7.89                                  | 1.23                                    | 1.68                                    |
| Magnesia . . . . .                            | 1.55                                  | 1.06                                    | .98                                     |
| Ferric oxide . . . . .                        | 2.02                                  | 2.35                                    | 3.90                                    |
| Sand . . . . .                                | 13.83                                 | 4.34                                    | 63.43                                   |
| † Containing Nitrogen . . . . .               | 7.97                                  | 4.37                                    | .43                                     |

**CHEMICAL  
COMPOSITION.**

Analyses of guano from the Federated Malay States were made in 1905 by Professor Dunstan. Professor Dunstan had four samples. Sample A had been taken from the limestone caves at Padang Rengas in Perak, about 16 miles from Taiping: it was dark buff in colour and contained small white fragments of calcium sulphate and phosphate. Samples 1-3 had been taken from the Batu Caves at Selangor in the Federated Malay States: the first had been taken from within three inches of the surface and was reddish-brown; the second had been taken from a depth of six inches and was dark brown; the third had been taken from the depth of one foot and was light yellowish-brown. Analysed, the following figures were obtained:—

|  | A.<br>Per cent. | No. 1.<br>Per cent. | No. 2.<br>Per cent. | No. 3.<br>Per cent. |
|--|-----------------|---------------------|---------------------|---------------------|
| Silica . . . . .   | 9.42            | 31.62               | 19.79               | 21.77               |
| Alumina . . . . .  | 2.56            | 11.36               | 10.73               | 10.59               |
| Ferric oxide . . . . .   | 1.75            | 11.03               | 9.05                | 8.24                |
| Manganous oxide . . . . .                                      | .31             | .20                 | .19                 | .13                 |
| Lime . . . . .   | 22.27           | 1.81                | 1.86                | 2.52                |
| Magnesia . . . . .   | trace           | 1.01                | 1.04                | .95                 |
| Cupric oxide . . . . .   | .34             | .37                 | .35                 | .34                 |
| Potash . . . . .   | 2.61            | 1.12                | .88                 | .88                 |
| Soda . . . . .   | 1.30            | .78                 | .75                 | .73                 |
| Ammonia . . . . .  | .58             | .12                 | .14                 | .12                 |
| Nitric acid . . . . .  | 7.55            | .81                 | .91                 | .81                 |
| Phosphoric acid . . . . .                                      | 17.52           | 8.60                | 10.86               | 11.17               |
| Sulphuric acid . . . . .                                       | 16.92           | .41                 | .53                 | .50                 |
| Chlorine . . . . .   | .13             | trace               | trace               | ..                  |
| Combined water . . . . .                                       | 4.36            | 2.91                | 2.62                | 2.24                |
| Moisture . . . . .   | 9.59            | 21.26               | 22.92               | 29.00               |
| Organic matter . . . . .                                       | 4.88            | 6.57                | 17.21               | 9.62                |
| Total nitrogen . . . . .                                       | 2.17            | .81                 | 1.52                | .84                 |
| Phosphoric acid soluble in water . . . . .                     | .81             | ..                  | ..                  | ..                  |
| Phosphoric acid soluble in ammonium citrate solution . . . . . | 3.25            | 7.28                | 8.54                | 9.75                |

The analyses are only moderately instructive because the deposits of guano evidently contained many fragments of rock from the cave walls.

Professor Dunstan comments on the analyses as follows:—

“These guanos are comparatively rich in phosphoric acid, of which a fairly large proportion is....in a form in which it could be utilised by plants: they are deficient in....potash and nitrogen .... The best of the four bat guanos is sample A, which contains 2 per cent. of potash, 2.47 per cent. of nitrogen in the form of ammonium nitrate, and 17.52 per cent. of phosphoric acid in the form of ferric, aluminium and calcium phosphates ..... The phosphoric acid content of this guano would be worth about £2 16s. per ton in this country (England), and it is unlikely

that the small amount of 'Nitrogen' and potash present would **VALUE** enhance its commercial value. This price is undoubtedly too low to permit of profitable export and it would probably prove more remunerative to employ the guano locally."

Professor Dunstan notes that the phosphoric acid content increases downwards.

He obtained from dealers in guano the information that similar samples of guano had been brought into England from Mexico, Borneo, Algeria, Jamaica and elsewhere, but had not been received with favour.

I find recorded in my office the results of the examination of a sample of guano from Upper Burma (locality of origin not recorded). The sample was very deficient in nitrates, none being present in the form of salts of ammonia; and I think it had been indiscriminately taken from some spot where water had been able to wash those salts out.

On the whole then both by reason of the smallness of the supply and because the material is not in demand in Europe, the supply must be used up locally. It would probably be of great interest to see if the guano is now used in the most economical way; for it is evident that the vegetables it is used to stimulate need to obtain nitrogen from other sources, and if the soil is not rich in these, the phosphates of the guano are superabundant.

The deposits of bat's guano in India proper appear to be practically confined to those of the Kurnool and Nellore districts in the Madras <sup>Deposits in Madras.</sup> Presidency.

The earliest recorded mention of them is to be found in a report on Experimental Farms, Madras, 1883, p. 10 :—

"The existence of large deposits of bat guano in a cave called Yerrayari situate in the Banganapalle jaghire in the Kurnool district was brought to notice during the year by Mr. Bruce-Foote of the Geological Survey of India. Mr. Bruce-Foote said that he found it being carted by a party of melon-growers from Chennoor, a village in the Cuddapah district 75 miles off. Enquiry showed that its value as a manure was but little recognised locally. From a quantitative analysis of it for this Department by the Chemical Examiner, it would appear to be a most valuable manure, being particularly rich in ammonia. There are similar deposits of guano in caves under the Dolphin's Nose, a promontory on



**DEPOSITS IN MADRAS.** the North-East coast close to Vizagapatam, but the caves are practically inaccessible, and the deposits are but little drawn upon."

The next recorded notice of this guano occurs in the following passage from the Manual of the Kurnool district by Narahari Gopala Kristnamah Chetty, 1886, p. 164 :—" Bat guano is sometimes used in melon beds in the Kundur river. Recently it has been applied to paddy crops also with good results."

The Board of Revenue, Madras, reported in 1909 that "small quantities of guano have been found in the hills and caves of Nandyal and Koilkuntla taluks and in some of the reserved forests in the Markapur taluk, and that they to some extent are used as manure for melon gardens." And that the Collector of Nellore, on the authority of the District Forest Officer, had ascertained that fifteen cartloads of guano (bats' manure) can be collected annually in the Udayagiri and Kanigiri reserves whence it is still taken to Cuddapah for manuring melons.

**DEPOSITS IN BOMBAY.** Apparently a very small quantity of bat's dung is available in the hills of the Bezwada range. A small deposit occurs on the southern coast of Kathiawar, but owing to the difficulty of access the price is prohibitive.

**DEPOSITS IN THE NICOBARS.** In the annual report on the Nancowry Settlements, Nicobar Islands, for 1870-71, page 6, it was reported by Mr. G. H. Man that 3 or 4 ship-loads of guano could be got off the island of Katschall, and a far more extensive accumulation from Great Nicobar. Thirty bags were sent to Port Blair for report; but the results are not recorded. In the second and only other report published (being for the year 1871-72), page 5, Mr. J. N. Homfray, the Assistant Superintendent in charge of the Nicobars, alluded to the caves on Katschall island, and the guano in such a way as to make it evident that nothing more had been done.

In his "Text-book of Indian Agriculture," vol. v, page 190, Mr. James Mollison mentions the Nicobars as a source of guano, adding that the guano had found a use in Assam on tea gardens. I assume from this remark that some one had meanwhile shipped to Calcutta from the Nicobars a supply of guano of which I find no record.

Kloss in his book "In the Andamans and Nicobars" (London, 1903), p. 26, mentions the guano caves of Little Nicobar thus :—"In the rocky hill .... we discovered several caves, which run inwards from mouths situated at the water's level. These are

the homes of thousand of tiny leaf-nosed bats (*Hipposideros nicobarulae*, sp. nov.), and immense numbers of the bird's nest swift (*Collocalia hutchi*). The largest of these caves is about 50 feet deep and 20 feet high at the entrance; but at the back the accumulation of guano is so great that there is barely room to stand. As we entered with our lantern, our feet sinking ankle-deep into the soft chocolate coloured floor, there was a continual rush of little bats and birds overhead as they sought to escape.... The rock at the back was covered with countless numbers of the shallow cup-shaped nests of saliva-gummed moss. So closely were they built that in many cases one could not place a finger tip on the rock between them, and often they were constructed one on the side of the other. Fortunately for the birds, they are builders of the green variety of nests; for had there been white they would not long have remained undisturbed by the Chinese.... In the cave, the swallows breed at the inner end while the bats congregate near the mouth. Another small cave was inhabited by bats only."

The Chief Commissioner and Superintendent, Port Blair, has been so kind as to cause enquiries to be made regarding such guano deposits as Kloss mentions. They do not appear to be extensive enough to be a commercial asset. In the northern islands no guano was found, and in the central and southern islands but a thin deposit in caves where the swallows breed. A report sent to me by Lieutenant-Colonel H. A. Browning, under the date 30th March 1910, stated that no deposit of commercial value could be heard of.

There is a large cave at Shwe-male not far from Mandalay; but it apparently yields no guano. Deposits are found along the range of hills bordering on the Shan States and dividing them from the plains of the Irrawaddy. Near Kyaukse guano is reported to exist in a broad cleft between the rocks to an unknown depth, said to be several hundred feet.

Mr. LaTouche informs me that the extensive limestone caves of the southern face of the Garo Hills house great colonies of bats near their mouths, but the wash of water during the rains sweeps any deposit away.

There are guano caves in the Peshāwar district. In the Gazetteer of the district, edition of 1883-84, a cave is mentioned under the Pushtu name of Kashmir Smats, as existing near the summit of the Sakr ridge of Pajja, eight miles north-west of Bazar in

**DEPOSITS IN  
THE PESHAWAR  
DISTRICT.**

the tappah Sadhuun, but best approached from Babazai in the tappah Bazai, which General Cunningham had identified with Hui Tsang's "Cave of Prince Sadana in mount Dantalok." The cave, it is said in that Gazetteer, had not been thoroughly explored: its neighbourhood was full of ruins. As recorded in the Gazetteer of the district, edition of 1897-98, the cave was afterwards made more accessible by a pony road from Pirsai; and it had been explored. The limestone was found to have been cut into three chambers of considerable length, the third of which, 80 feet high and above 80 feet in diameter, with an opening in the roof, held there a deposit to a depth of several feet of pigeons' and bats' dung. This cave had been a shrine.

Enquiry from the Deputy Commissioner, Peshawar, obtained for me information kindly sent by Mr. L. M. Crump, I.C.S., Assistant Commissioner, Mardān District, that the nearest villages are remote from the cave and the dung finds no use. He continued: "there are some very small deposits near Hamza-kote which are used by the Khan of the village as manure in his garden..... and caves with small deposits at Kamitro Gut near Chayuli, Tarnab-Dara near Sikri, and Sikri-Dara near Shakar Tanji. None of the deposits are of any appreciable extent.... Except the very small deposits at Hamza Kote, none are used regularly owing to the distance of the places from villages and difficulties of access and transport."

**GUANO  
a medicine in  
Baluchistan.**

Bats' guano is a drug in parts of Baluchistān under the name of Kam-yaft. Mr. R. Hughes-Buller sent it to me as such in 1903 from the Pab hills, with the information that it is taken for gonorrhœa in the form of a draught.

**DEPOSITS IN  
CEYLON.**

In January 1908, Mr. J. A. Daniel visited the nitre cave at Wellawaya, Uva, and sent an interesting description to *Spolia Zeylanica*, vol. v, p. 107. This cave is mentioned by Dr. John Davy in his "Account of the Interior of Ceylon" (1821), page 429. The surroundings of the cave are scarcely changed. The cave is in the heart of a forest about  $2\frac{1}{2}$  miles from the Koslanda-Wellawaya road. The number of bats was enormous, and the floor of the cave was covered with the excrement of the bats to a depth of five feet. Much of the manure had been converted into saltpetre by chemical decomposition. Davy states that this cave was worked for many years for saltpetre by a party of natives who came annually from Passora for the purpose. The economic

**Saltpetre  
Manufacture.**

value of tons of manure available in this and several other caves **DEPOSITS IN CHINA.** is yet to be proved.

The Chinese supply alluded to in the first sentences of this note comes from Chiung Chou near Chengtu in Szechuan and finds its use as a medicine under the name of Yeh-ming sha (*vide* Hosie, Report on the Province of Ssueh'uan, 1904, p. 51). I have not been able to find that any is used to help on the intense cultivation of the plain of Chengtu.

Many works of travel in China speak of caverns. Gill for instance (*The River of Golden Sand*, London, 1880, I. p. 347) says of country quite close to Chengtu "There were a great many caves and caverns in the sides of the hill." And a little further on he writes of limestone cliffs. While Jack (*The back-blocks of China*, pages 48 and 116) mentions sandstone caves—as occurring on the south of Chengtu. But neither these nor any other authors that I have consulted definitely say anything about the source and supply of bats' guano from them.



